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(71) Applicant(s)
The Arbitron Company

(Incorporated in USA - Delaware)

312 Marshall Avenue, Laurel, Maryland 20707, United States of America

(72) Inventor(s)
Michel Fardeau
Michel Briend

(72) cont
Marc Tommasi
Serge Galant

(74) Agent and/or Address for Service
Boult Wade Tennant
27 Furnival Street, LONDON, EC4A 1PQ, United Kingdom

(54) Automatically identifying a program including a sound signal

(57) In a method and apparatus for automatically identifying a program broadcast by a radio station or by a television channel, or recorded on a medium, by adding an inaudible encoded message to the sound signal of the program, the message identifies the broadcasting channel or station, the program, and/or the exact date. In one embodiment the sound signal is transmitted via an analog-to-digital converter 12 to a digital data processor 14 enabling frequency ranges to be split up, enabling the energy in some of the frequency ranges to be altered in a predetermined manner to form an encoded identification message, and with the output from the data processor being connected via a digital-to-analog converter 26 to an audio output 28 for broadcasting or recording the sound signal. The invention is particularly applicable to measuring the audiences of programs that are broadcast by radio or television, or that are recorded.

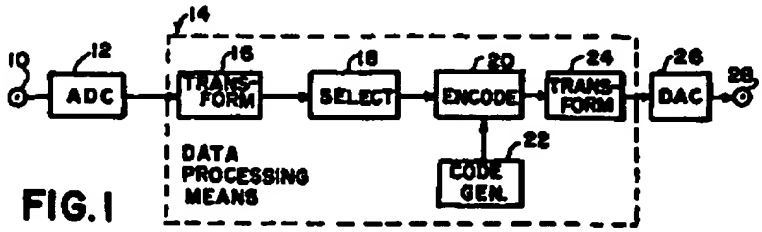

FIG.1

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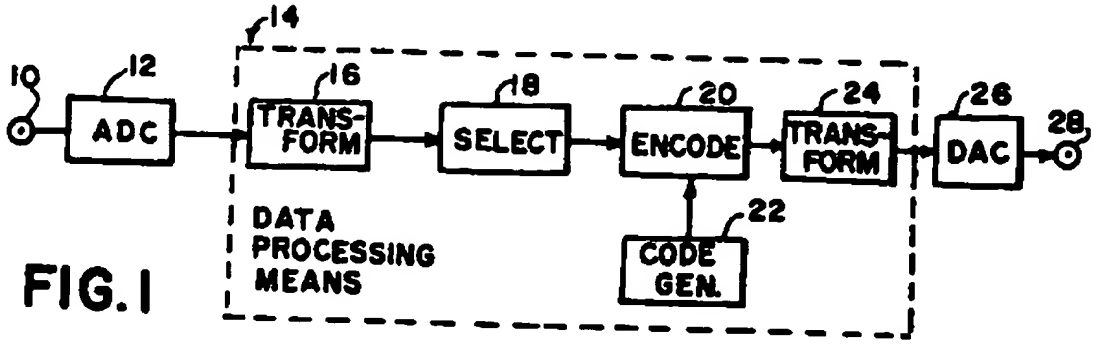

FIG. 1

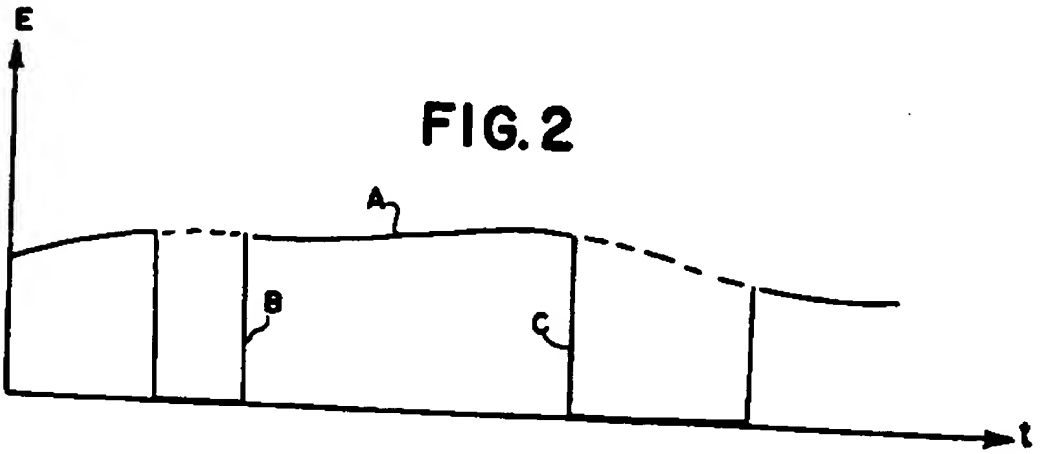

FIG. 2

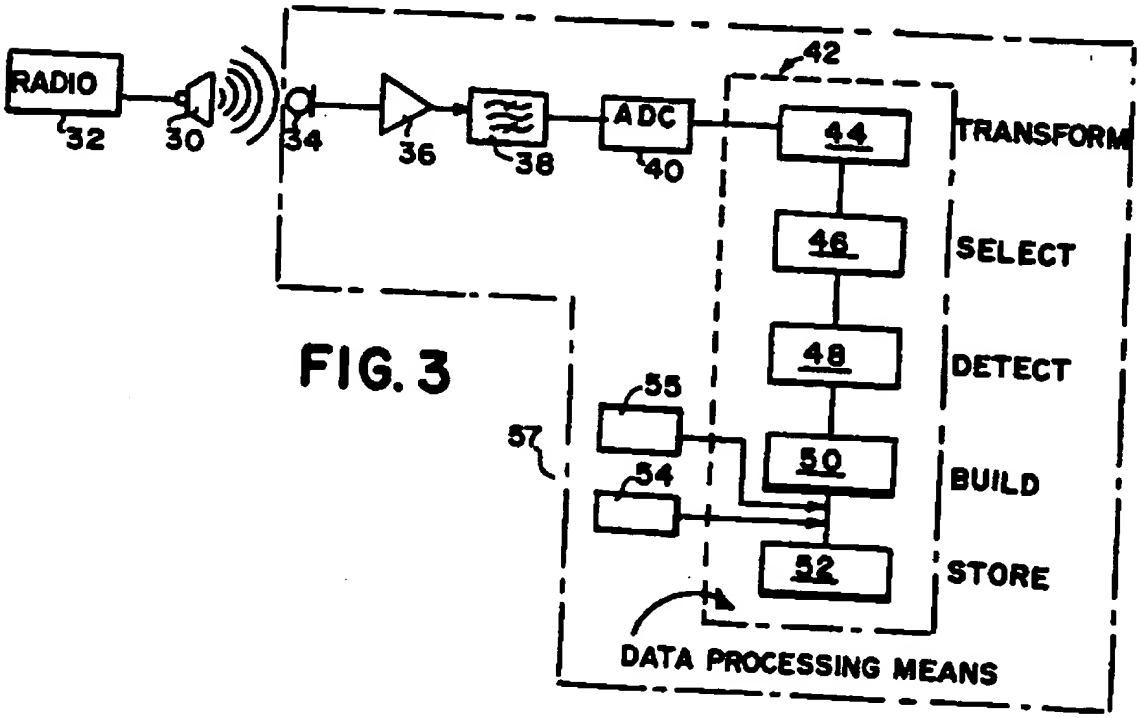

FIG. 3

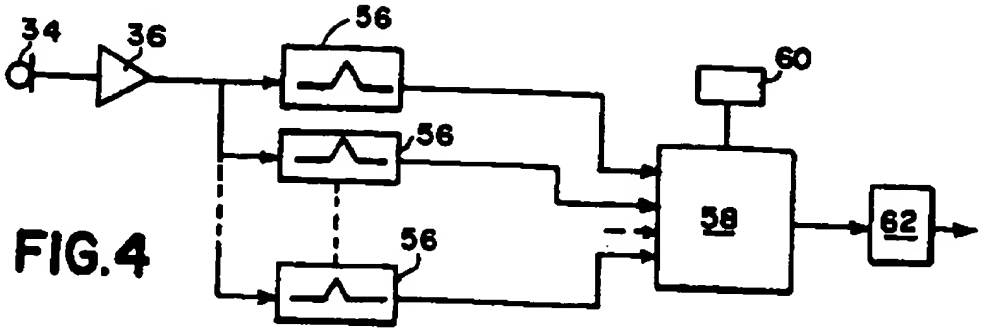

FIG.4

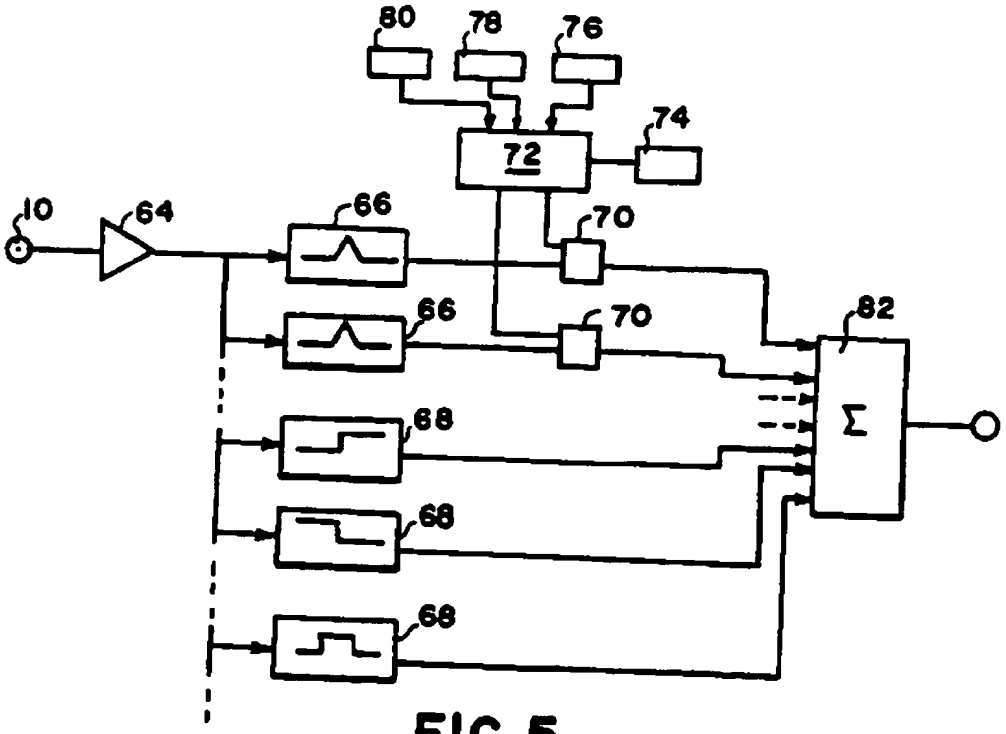

FIG. 5

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METHOD AND APPARATUS FOR AUTOMATICALLY IDENTIFYING A PROGRAM INCLUDING A SOUND SIGNAL

The invention relates to a method and to apparatus for automatically identifying a program including a sound signal, such as a radio program or a television program, in particular, or a program recorded on a medium such as a microgroove disk, a magnetic tape, a compact disk for reading by laser, or a video disk.

Such automatic identification of programs is applicable to measuring the audience of radio stations or television channels, to monitoring the inclusion of advertising programs in television or radio broadcasts, or indeed to keeping an account of royalties due to authors or to performers for public broadcasting of their works.

It has been proposed to add an inaudible coded message to the sound signal of a program to be identified, the encoded message comprising information such as the identity of the broadcasting channel or station, the identity of the program, and possibly the exact date of transmission. A specialized decoder associated with a television or radio receiver serves to extract the encoded message added to the sound signal and to record it in a memory.

To ensure that the encoded message is inaudible on being output from the loudspeaker(s) of a receiver, it must either be at a very low frequency (e.g. 40 Hz), or else it must be at an audible frequency but emitted at a level that is well below the level of the sound signal (in the range -50 dB to -60dB).

The essential drawback of these proposed means is that they require a specialized decoder to be integrated in the television or radio receiver. The characteristics of the loudspeakers in such receivers are such that in general they do not pass signals at frequencies below about 100 Hz. When the encoded message is emitted on an audible frequency but at a level that is

well below the level of the sound signal, it is also very difficult to pick up the message using a microphone, particularly since the directivity of a loudspeaker increases with frequency, as does the attenuation of the signal it reproduces.

Another proposed technique consists in using one type of modulation for broadcasting the sound signal and another type of modulation for broadcasting the encoded message. Here again, it is necessary for a specialized decoder to be integrated in the receiver in order to be able to recover the encoded message.

An object of an embodiment of the present invention is to provide a method and apparatus for automatically identifying a program including a sound signal in which there is an inaudible encoded message, by means of a decoder that is totally independent of the receiver for receiving the program.

Another object of an embodiment of the invention is to provide a method and apparatus of this type enabling the audiences of radio and television broadcasts to be measured.

Yet another object of an embodiment of the invention is to provide a method and apparatus of this type which makes it simple to monitor the broadcasting of works recorded on media such as microgroove disks, magnetic tapes, compact disks for reading by laser, or video disks.

To this end, the present invention in accordance with one aspect thereof provides a method of automatically identifying a program that includes a sound signal, by including an inaudible encoded message in the sound signal, the message containing data corresponding to the identity of a broadcasting channel or station, to the identity of the program, and/or to the exact date of broadcasting, the method comprising the steps of selecting at least one narrow band of audible frequencies in the sound signal, altering the energy of the sound signal in said frequency band in a characteristic manner that is predetermined and repeated, and broadcasting the

sound signal including the alterations or in recording it on a medium.

Preferably, the alterations to the energy in the sound signal in said frequency band are of the pulse or quasi-pulse type.

Compared with the prior art, this method presents several advantages:

the alterations applied to the energy of the sound signal in a narrow band of audible frequencies can be reproduced without difficulty by the loudspeaker of a receiver while still remaining completely inaudible, regardless of the quality of the loudspeaker;

a program-identifying message can be built up by repeating these alterations in compliance with a predetermined code, which message may include a relatively large amount of information such as the identity of the broadcasting channel or station, the identity of the program itself, and the exact date of transmission;

the quality of the sound signal including the encoded message is not audibly degraded;

the general frequency spectrum of the sound signal is not perceptibly changed by adding the encoded message;

the total energy of the sound signal is not perceptibly changed;

the method of the invention is applicable regardless of the type of modulation used for transmitting the sound signal;

the encoded identity message may be detected in the sound signal reproduced by the loudspeaker of a receiver (or of an apparatus for playing back a recording) by means of a decoder situated within the listening area of the loudspeaker without there being a need to provide any kind of connection between the decoder and the receiver or playback device;

the decoder may be portable; and

it may be installed permanently in the listening area of the loudspeaker of a receiver or playback device, or else it may be carried about by a person.

According to another aspect of the invention, the method comprises comparing the energy of the sound signal in said frequency band with a threshold and in altering said energy only if it is greater than the threshold.

In this way, the encoded message is not added to the sound signal of the program during periods of silence, during which it would otherwise be audible.

The duration of the pulses altering the sound signal in said narrow frequency band is preferably less than about 100 ms, e.g. about 10 ms.

The repetition rate of these pulses may lie in the range 5 Hz to 20 Hz, for example.

The narrow frequency band including the encoded message preferably lies between about 100 Hz and about 700 Hz and may be a few tens of hertz wide.

The energy of the sound signal in said frequency band may be altered by reducing said energy to a value that is substantially zero, or on the contrary by increasing said energy to a predetermined value.

According to another aspect of the invention, the method also comprises selecting at least two narrow frequency bands of the sound signal and in altering the energy of the sound signal in said two frequency bands simultaneously in a manner that is predetermined and repeated to encode the identity message.

The encoding data rate can thus be increased by simultaneously adding different portions of the message in a plurality of narrow frequency bands in the sound signal.

It is thus also possible to improve the inaudibility of the encoded message by reducing the energy of the sound signal in one frequency band while

increasing said energy in another frequency band so as to compensate for the changes of energy in the sound signal between the two frequency bands.

According to another aspect of the invention, the method comprises splitting up the sound signal into frequency components, either in analog manner by filtering or else in digital manner by a Fourier transform or by a wavelet transform, altering the energy of the frequency components lying in the above-mentioned frequency band(s) in a manner that is predetermined, and then rebuilding the sound signal and in broadcasting it or recording it on a medium.

According to yet another aspect of the invention, the method comprises picking up the sound signal containing the encoded identification message when the signal is reproduced by a loudspeaker, detecting the alterations made to the energy of the signal in at least one of the above-mentioned frequency bands, deducing the encoded identification message therefrom, and storing the message in a memory.

One or more frequency components are extracted from the sound signal picked up at the outlet from the loudspeaker either in analog manner by filtering or in digital manner by a Fourier transform, or by a wavelet transform, and then the above-mentioned alterations that constitute the encoded message are detected in the frequency component(s) corresponding to the above-mentioned narrow frequency band(s).

In accordance with a still further aspect, the invention also provides apparatus for automatically identifying a program that includes a sound signal conveying an inaudible encoded message comprising data corresponding to the identity of a broadcasting channel or station, to the identity of the program, and/or to the exact date of broadcasting, the apparatus comprising means enabling the energy of the sound signal in at least one previously determined narrow band of audible

frequencies to be altered in a manner that is predetermined and repeated, the set of alterations produced in this way constituting the encoded message.

This apparatus further comprises code generation means transforming channel, station, program and/or date identity data into a least one sequence of pulse or quasi-pulse signals defining the alterations to be made to the energy of the sound signal in the, or each, above-mentioned frequency band.

Preferably, this apparatus comprises means for comparing the energy of the signal in said frequency band with a threshold, and means for preventing said energy being altered when it is below the threshold.

In a first embodiment, this apparatus comprises analog-to-digital conversion means for the sound signal, said conversion means being connected to data processing means receiving the digitized signal and designed to split it up into frequency components, to alter the energy of the signal in said frequency band in compliance with the encoded message to be included, and to rebuild the signal from its frequency components, together with digital-to-analog conversion means connected to the output of the data processing means.

In another embodiment, this apparatus comprises a set of frequency filters connected in parallel and receiving the sound signal on their inputs, said set comprising at least one bandpass filter for extracting the above-mentioned narrow frequency band from the sound signal and for applying it to one input of a controlled switch whose other input is connected to an output of code generator means, the set of filters also comprising lowpass and highpass filters for transmitting the frequencies of the sound signal that are not included in the above-mentioned frequency band, and a summing circuit whose inputs are respectively connected to the output of the controlled switch and to the outputs of the lowpass and highpass filters to reconstitute the sound signal.

According to another aspect of the present invention there is provided a method for including an inaudible encoded message in a sound signal forming at least a part of a program, the message containing data indicating at least one of a broadcasting channel or station providing said program, an identity of said program and a broadcasting date of said program, comprising the steps of selecting at least one band of audible frequencies in the sound signal, altering the energy of the sound signal in said at least one band of audible frequencies in a characteristic manner that is predetermined and repeated to form an encoded sound signal, and at least one of broadcasting the program including the encoded sound signal and recording the encoded sound signal on a recording medium.

According to another aspect of the present invention there is provided an apparatus for including an inaudible encoded message in a sound signal forming at least a part of a program, the message containing data indicating at least one of a broadcast channel or station providing said program, an identity of said program and a broadcasting date of said program, comprising means for selecting at least one band of audible frequencies in the sound signal, and energy alteration means for altering the energy of the sound signal in said at least one band of audible frequencies in a characteristic manner that is predetermined and repeated to form an encoded sound signal.

One embodiment further comprises code generation means for transforming at least one of channel, station, program and date identity data into at least one sequence of pulse or quasi-pulse signals and the energy alteration means is operative to alter the energy of the sound signal in said at least one band

of audible frequencies in response to said pulse or quasi-pulse signals.

In another embodiment, said selecting means comprises at least one bandpass filtering means for separating said at least one band of audible frequencies from said sound signal, lowpass filtering means for separating low frequency portions of said sound signal having frequencies less than said at least one band of audible frequencies from said sound signal and highpass filtering means for separating high frequency portions of said sound signal having frequencies greater than said at least one band of audible frequencies, said energy alteration means comprises switching means coupled with said bandpass filtering means to receive said at least one band of audible frequencies for selectively providing said at least one band of audible frequencies at an output thereof in response to said at least one sequence of pulse or quasi-pulse signals from said code generation means to encode said at least one band of audible frequencies, said apparatus further comprising summing means for combining the at least one encoded band of audible frequencies with the low and high frequency portions of said sound signal to form the encoded sound signal.

In accordance with yet another aspect, the invention also provides at least one device for decoding the message included in the sound signal, said device being intended to be located in range of a loudspeaker reproducing the signal, the device comprising a microphone for picking up the signal reproduced by the loudspeaker, means for processing said signal to detect the alterations made to the energy of the signal in the above-mentioned narrow frequency band(s) and for deducing therefrom the message included in the signal, and means for storing said message in a memory.

In a first embodiment, the decoding device comprises an analog-to-digital converter connecting the output of the microphone to the input of data processing means including at least one microprocessor enabling the signal digitized at the output from the microphone to be split up into frequency components, enabling the alterations of the energy in the frequency components of the signal to be detected in the above-specified frequency band(s), enabling the encoded message to be deduced therefrom, and enabling it to be recorded in a memory.

In another embodiment, the decoding device comprises at least one bandpass filter receiving the output signal from the microphone to extract therefrom the frequency band conveying the encoded message and to apply it to analog circuits for detecting the alterations made to the sound signal in said frequency band.

The decoding device is easily made portable and may include a motion detector.

In accordance with a still further aspect of the invention, a method of estimating an audience for widely disseminated audible information is provided wherein the widely disseminated audible information includes an inaudible identification code indicating a source thereof and included within at least one band of frequencies of the widely disseminated audible

information by modifying an energy level of a portion of an audible signal of the widely disseminated audible information within the at least one band of frequencies. The method comprises the steps of: selecting a group of individuals from among the audience; providing each of the individuals with a respective personal monitoring device capable of being carried on the person of each such individual, the personal monitoring device including means for converting sounds including the widely disseminated audible information received thereby into a processing signal, means for extracting the inaudible identification code from the processing signal by detecting the modifications to the energy level thereof within the at least one band of frequencies, and means for storing information from the extracted code indicating the source of the widely disseminated audible information; collecting information concerning widely disseminated audible information provided to each of the group of individuals during a predetermined time period with the use of each respective personal monitoring device carried thereby by extracting inaudible identification codes from processing signals converted from sounds including said widely disseminated audible information received by the respective monitoring device carried by each of the group of individuals and storing the information from the extracted code; and producing an estimate of the audience for at least one source of widely disseminated audible information based on the collected information.

In one embodiment, the step of collecting information comprises extracting and storing identification codes representing radio and/or television stations and/or channels providing said

widely disseminated audio information as at least a part of a signal transmitted thereby.

In another embodiment, the step of collecting information comprises extracting and storing identification codes identifying radio stations transmitting radio signals as said widely disseminated audio information.

In another embodiment, the step of collecting information comprises extracting and storing identification codes representing television stations and/or channels providing said widely disseminated audio information as a part of a television signal transmitted thereby.

In another embodiment, the step of producing the audience estimate comprises transferring the information stored by each of the personal monitoring devices to a centralized processor and producing said audience estimate with the use of said centralized processor based on the information transferred thereto.

In accordance with yet still another aspect of the invention, a monitoring device is provided for use in collecting information for estimating an audience for widely disseminated audible information while carried on the person of an individual audience member, the widely disseminated audible information including an inaudible identification code indicating a source thereof and included within at least one band of frequencies of the

widely disseminated audible information by modifying an energy level of a portion of an audible signal of the widely disseminated audible information within the at least one band of frequencies. The monitoring device comprises: an enclosure; means for attaching the enclosure to the person of an individual audience member; transducing means for converting sounds including the widely disseminated audible information received thereby into a processing signal; code extraction means for extracting the inaudible identification code from the processing signal by detecting the modifications to the energy level thereof within the at least one band of frequencies; and storage means for storing information from the extracted code indicating the source of the widely disseminated audible information; the transducer means, the code extraction means and the storage means being carried within the enclosure.

The invention will be better understood and other aspects, details, and advantages thereof will appear more clearly on reading the following description given by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of apparatus of an embodiment of the invention for encoding a sound signal as broadcast by a radio station or by a television channel, or as recorded on a medium;

Figure 2 is a graph showing diagrammatically a portion of the way the signal is encoded in a narrow frequency band;

Figure 3 is a block diagram showing a decoder device in accordance with an embodiment of the invention;

Figure 4 is a block diagram showing a variant embodiment of the decoder device; and

Figure 5 is a block diagram of a variant embodiment of the device for encoding the sound signal of a program.

Reference is made initially to Figure 1 which is a block diagram of a first embodiment of apparatus for encoding the sound signal of a program transmitted by a radio station or by a television channel, or else recorded on a medium such as a microgroove disk, a magnetic tape, a compact disk for reading by laser, or a video disk.

The apparatus of the embodiment of the invention is designed to add an inaudible encoded identification message to the sound signal of the program that is to be broadcast or recorded on the medium.

To do this, the apparatus comprises an input 10 for the sound signal to be encoded, connected to the input of an analog-to-digital converter 12 whose output is connected to an input of data processing means 14 including at least one microprocessor, working memories, and memories for storing data.

The data processing means 14 are designed to perform an operation 16 of splitting up the digitized signal provided by the converter 12 into frequency components, with the splitting being conventionally performed by a Fourier transform, or else by a wavelet transform, thereby splitting up the signal in a frequency-time space. This wavelet transform is now well known to the person skilled in the art who may, if necessary, make reference to an article published in September 1987 at pages 28 to 37 in the journal "Pour la Science".

The digitized signal is split up into wavelets or Fourier series by executing a program recorded in a memory of the data processing means 14 and serves to encode one or more narrow frequency bands of the sound signal to include an encoded identification message therein. The frequencies chosen for encoding are audible frequencies, higher than about 100 Hz so as to lie in the passbands of the loudspeakers of television or radio broadcast receivers or devices for playing back

recordings. These frequencies are also less than 1000 Hz in order to avoid problems associated with loudspeaker directivity and with the attenuation of sound energy propagating in air, both of which problems increase with frequency.

The frequencies selected for encoding the sound signal are preferably chosen to lie in the range about 100 Hz to about 700 Hz. In practice, the identification message is not encoded on a single frequency, but on a relatively narrow band of frequencies having a bandwidth of a few tens of hertz, e.g. 50 Hz, or on a plurality of such narrow frequency bands.

The following operation 18 performed by the data processing means 14 consists in selecting frequency components of the signal corresponding to one or more of such narrow frequency bands in accordance with data that is previously stored in its memory.

The following operation 20 consists in encoding the energy in the selected frequency components. The encoding is of the pulse or quasi-pulse type and consists essentially in reducing the energy of the sound signal in each narrow frequency band under consideration to a value of substantially zero or else in increasing said energy up to a predetermined value, with this being done for short periods of time that are preferably less than about 100 ms so that the encoded message included in the sound signal is inaudible.

The data processing means 14 include code generator means 22 which transform the data constituting the identification message into sequences of pulses, which data may be constituted, for example, by the name of a radio station or of a television channel, the name of the program, and the exact date of broadcasting or recording. This data may be transformed by the means 22 into a sequence of bits or pulses that modulate in corresponding manner the energy of the sound signal in a frequency band, or the data may be transformed into a

plurality of sequences of bits or pulses that modulate the energy of the sound signal simultaneously in a plurality of frequency bands to increase the code rate.

It is also possible in this way to increase the inaudibility of the code message added to the sound signal, for example by encoding the message simultaneously by increasing the energy of the sound signal in one frequency band while reducing the energy in another frequency band.

The energy in the sound signal within a frequency band is preferably not encoded unless the energy therein is above a minimum value, so as to avoid adding the code message to the sound signal during a period of silence. This can be done merely by providing for the program recorded in a memory of the data processing means 14 to compare the energy of the sound signal in the frequency band under consideration with a predetermined threshold, to perform encoding of said energy so long as it is greater than the threshold, and to stop encoding when the energy is below the threshold.

The following operation 24 performed by the data processing means 14 consists in reconstituting a sound signal in digital form from the frequency components of the input signal that have not been encoded and the components that have been encoded. A digital signal is thus obtained at the output of the data processing means 14 corresponding to the input signal but including an encoded identification message.

This signal is applied to the input of a digital-to-analog converter 26 whose output is connected to an audio output 28 leading to conventional broadcasting or recording means.

Figure 2 is a diagram showing one example of how the energy of the sound signal may be encoded in a narrow band of audible frequencies. Curve A shows how the energy of the sound signal varies as a function of time, and notches B and C show two code pulses during

which the energy is reduced to substantially zero. In the example shown, the first pulse B has a duration of 10 ms, the second pulse C has twice the duration, i.e. 20 ms, and it begins about 50 ms to about 100 ms after the beginning of the first pulse B.

Any type of code may be used for transforming the data of the identification message into sequences of pulses, and, for example, such codes may be characterized by pulses of fixed or varying duration, by the repetition rate of the pulses, by groups of pulses, etc.

In general, the identification message may be encoded on a number of bits lying in the range about 50 to about 100, thereby including sufficient redundancy to reduce the risks of error on decoding, with the duration of the encoded identification message lying in the range about 3 s to about 20 s and with the repetition rate of its bits lying in the range 5 Hz to 20 Hz.

Under such conditions, the encoded identification message included in the sound signal is inaudible when the signal is reproduced by a high quality loudspeaker.

Figure 3 is a block diagram of a decoding device of an embodiment of the invention which is placed in the listening area of a loudspeaker 30 of a device 32 for receiving a program or for playing back a recording of the program.

The decoding device comprises a microphone 34 picking up the sound signal reproduced by the loudspeaker 30, and connected via amplifier means 36 to a bandpass filter 38 whose passband comprises the narrow frequency band(s) that convey the encoded message identifying the program. The output from the filter 38 is connected by an analog-to-digital converter 40 to an input of data processing means 42 which comprise at least one microprocessor together with working memory and memory for storing data. These data processing means 42 begin at 44 by splitting up the frequencies of the digital signal provided by the converter 40, then at 46 in

selecting the frequency components that include the encoded identification message, and then detecting at 48 the alterations in the energy of the signal in said frequency components that correspond to the code bits of the identification message. The following operation 50 consists in reconstituting the encoded message which is then stored in a memory 52.

The decoding device may optionally also include a motion detector 54, such as an accelerometer for example, with the output signal therefrom being added in any appropriate manner to the reconstituted code message prior to storing it in the memory, to indicate whether or not the decoding device is being moved by a person.

It is also possible to use a temperature detector 55 in addition to the motion detector, since the temperature of the decoding device increases perceptibly if it is worn by a person. Where the decoding device is worn by a person it is housed in a appropriate enclosure, indicated schematically by the one-dot chain line 57 in Figure 3, including appropriate means for attaching the enclosed decoding device to the person or the person's clothing. Advantageously, the enclosure is the size of a pager or smaller to permit it to be worn comfortably and conveniently by the person.

The advantage of such motion and/or temperature detectors is, for example, that it makes it possible to associate the identity of the person wearing the decoding device with the automatic identification of the programs that person listens to on a radio or a television or on a device for playing back a recording.

The decoding device of an embodiment of the invention thus makes it possible to store in its memory the program identification messages that it picks up successively over some length of time. The contents of the memory can be transferred at regular intervals by any appropriate means to a central processor unit which decodes the identification messages and deduces program audience

measurements therefrom, or which lists the programs picked up by a decoding device placed at a given fixed location. The data collected by the central unit can also be used to monitor the broadcasting of advertising programs.

Figure 4 is a diagram showing another embodiment of the decoding apparatus, in which the sound signal picked up by the microphone 34 is processed by analog means instead of by digital means.

To do this, the output from the microphone 34 is connected via the amplifier means 36 to a set of filters 56 connected in parallel, with the outputs therefrom being connected to the inputs of a circuit or set of circuits 58 for detecting code pulses formed in the above-mentioned narrow frequency bands. In conventional manner, a synchronizing clock 60 is associated with the circuit 58 or with each of the circuits 58.

The output from the, or each, circuit 58 is connected to means 62 for rebuilding the encoded message, which message is then stored in a memory.

Each filter 56 is a switched capacitance filter enabling a frequency band to be extracted from the sound signal picked up by the microphone 34 corresponding to one of the frequency bands selected in the encoding apparatus. The passband of each of the filters 56 may possibly be greater than that of the frequency band used for encoding the identification message, e.g. because of distortion or harmonic dispersion in the sound signal as played back by the loudspeaker. It is also possible to provide a plurality of filters 56 having substantially adjacent passbands.

The bits constituting the enclosed message are detected in the circuit(s) 58 by detecting rising and falling edges in the energy alterations in the sound signal or in the frequency bands in question, and by monitoring the durations of such alterations.

Figure 5 is a block diagram of another embodiment of the encoding apparatus, which in this case is of the analog type.

The audio input 10 for the sound signal to be processed is connected via amplifier means 64 to a set of frequency filters connected in parallel and comprising one or more bandpass filters 66 whose pass bands correspond to the narrow frequency bands to be encoded, together with sets of highpass, lowpass, and possibly bandpass filters 68 for transmitting the frequency components of the sound signal that are not involved in the encoding.

The output from each bandpass filter 66 is connected to an input of a controlled switch 70 that performs the function of an AND gate and that has another input receiving a control signal provided by code generator means 72 associated with a synchronizing clock 74 and serving to transform into sequences of bits the data delivered thereto by means 76 for identifying the broadcasting channel or station, means 78 for identifying the program, and a clock 80 for dating purposes.

The outputs of the switches 70 are connected to inputs of a summing circuit 82 as are the outputs from the other filters 68. The output signal from the summing circuit 82 is the reconstituted initial sound signal but now including the encoded program identification message.

In general, the encoded identification signal may be added discontinuously to the program sound signal, or else continuously with the encoded message being repeated endlessly in the program sound signal.

The invention thus makes it possible to encode an identification message in the sound signal of a program, which message is inaudible when the sound signal is reproduced by loudspeakers, even if they are of very high quality, with the frequency and level characteristics of the encoded message nevertheless enabling it to be reproduced even by loudspeakers of very

poor quality, thereby enabling the message to be picked up and extracted from the sound signal under very bad playback conditions.

The processing applied to the sound signal by the encoding apparatus gives rise to a delay in the transmission of the sound signal, which delay may be about 0.1 second to about 1 second. For a video program this requires the image and the sound to be resynchronized after the sound signal has been encoded. Such resynchronization is commonplace for the person skilled in the art.

Further features described herein are claimed in the Applicant's co-pending application published under Publication No. GB 2260246.

CLAIMS

1. A method for including an encoded message in a sound signal forming at least a part of a program such that the message is inaudible, the message containing data indicating at least one of a broadcasting channel or station providing said program, an identity of said program and a broadcasting data of said program, comprising the steps of separating the sound signal into frequency ranges by digital processing, altering the energy of at least one of the frequency ranges in a characteristic manner that is predetermined, reconstructing the sound signal from the separated frequency ranges including the frequency range whose energy has been altered to form an encoded sound signal and at least one of broadcasting the program including the encoded sound signal and recording the encoded sound signal on a recording medium.

2. A method as claimed in Claim 1, comprising separating the sound signal into frequency ranges by one of digital Fourier transform and digital wavelet transform.

3. A method according to Claim 1 or 2, wherein the alterations to the energy in the sound signal in said at least one frequency range are of the pulse or quasi-pulse type.

4. A method according to any preceding claim, further comprising the step of comparing the energy of the sound signal in said frequency range with a threshold and wherein the step of altering the energy of the sound signal comprises altering said energy

only if it is greater than the threshold.

5. A method according to Claim 3 or 4, wherein the alteration pulses have a duration of less than about 100 ms.

6. A method according to Claim 5, wherein the alteration pulses have a duration of about 5 ms to about 10 ms.

7. A method according to any of Claims 3 to 6, wherein the repetition rate of said pulses is about 5 Hz to about 20 Hz.

8. A method according to any preceding claim, wherein said range of audible frequencies has a width of a few tens of hertz and lies between about 100 Hz and about 700 Hz.

9. A method according to any preceding claim, wherein the alteration of the energy of the sound signal in said at least one range of audible frequencies comprises reducing said energy to a value of substantially zero.

10. A method according to any preceding claim, wherein the alteration of the energy of the sound signal in said at least one range of audible frequencies comprises increasing said energy to a predetermined value.

11. A method according to any preceding claim, wherein the step of selecting at least one band of audible frequencies comprises selecting at least two frequency bands of the sound signal and the step of

least two frequency bands simultaneously in a manner that is predetermined and repeated.

12. An apparatus for including an encoded message in a sound signal forming at least a part of a program such that the encoded message is inaudible, the message containing data indicating at least one of a broadcast channel or station providing said program, an identity of said program and a broadcasting date of said program, comprising analog-to-digital conversion means for converting the sound signal to digital form, data processing means for selecting at least one band of audible frequencies in the digitized sound signal by splitting the digitized sound signal into a plurality of frequency components at least one of which falls within said at least one band of audible frequencies, said data processing means being further operative to alter the energy of the at least one frequency component within said at least one band of audible frequencies in a characteristic manner that is predetermined to encode said at least one frequency component with data of said inaudible encoded message, and to combine said plurality of frequency components including the at least one encoded frequency component to form an encoded digital sound signal, the apparatus further comprising digital-to-analog conversion means for converting the encoded digital sound signal to analog form as said encoded sound signal.

13. Apparatus according to Claim 12, further comprising code generation means for transforming at least one of channel, station, program and date identity data into at least one sequence of pulse or quasi-pulse signals and the energy alteration means is operative to alter the energy of the sound signal in

said at least one band of audible frequencies in response to said pulse or quasi-pulse signals.

14. Apparatus according to Claims 12 or 13, further comprising means for comparing the energy of the signal in said at least one band of audible frequencies with a threshold, and means for preventing said alteration of said energy when it is below the threshold.

15. An apparatus for recovering an identification message encoded in a sound signal forming at least a part of a program, the identification message being encoded by altering the energy of the sound signal in at least one band of audible frequencies thereof, the sound signal being reproduced by a loudspeaker, comprising: microphone means for converting the sound signal reproduced by said loudspeaker into an electrical sound signal, analog-to-digital converter means for converting the electrical sound signal to digital form, data processing means for splitting the digitized sound signal into a plurality of frequency components at least one of which falls within said at least one band of audible frequencies, said data processing means being further operative to detect alterations in the energy of the at least one frequency component, to retrieve the identification message from the detected alterations and to store the identification message in a memory.

16. Apparatus according to Claim 15, further comprising means for enclosing said apparatus such that said apparatus may be carried on a person.

17. A method of recovering an identification message encoded in a sound signal forming at least a part of a program, the identification message being encoded by altering the energy of the sound signal in at least one band of audible frequencies thereof, the sound signal being reproduced by a loudspeaker, comprising the steps of picking up the sound reproduced by the loudspeaker, detecting the alterations made to the energy of the sound signal in said at least one band of audible frequencies by extracting at least one frequency component of said sound signal by digital processing and determining whether said alterations are present in said at least one frequency component, retrieving the identification message from the detected alterations and storing the identification message in a memory.

18. A method substantially as hereinbefore described with reference to and illustrated by any one of the drawings.

19. An apparatus substantially as hereinbefore described with reference to and illustrated by any one of the drawings.

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): H04H 1/00,9/00

Other: online WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0366381 A2	Thorn EMI - see whole specification	
A	EP 0245037 A2	Thorn EMI - see page 3, lines 6-26; page 7, lines 4-8; and page 13	
A	US 4972471	Gross et al. - see columns 1 and 2	
A	US 4703476	Audicom Corp. - see column2, line 40 to column3, line 3	
A	US 3004104	Hembrooke - see abstract	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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